Printed Pages : 4 **TAS – 101 / 201**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 9927 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. II) EXAMINATION, 2007-08

PHYSICS

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*
*(2) **Each** question carries **equal** marks.*
(3) The physical constants are given at the end of the question paper.

1 Attempt any **four** parts of the following : **5×4=20**

(a) Show that the distance between any two points in two inertial frames is invariant under Galilean transformation.

(b) How fast would a rocket have to go relative to an observer for its length to be contracted to 99% of its length.

(c) Explain why a moving clock appears to go slow to a stationary observer ?

(d) Show that for small velocities the relativistic kinetic energy of a body reduces to the classical kinetic energy, which is less than the rest energy.

(e) Show that the massless particles can exist only if they move with the speed of light and their energy E and momentum p must have the relation, $E = pc$.

(f) How much does a proton gain in mass when accelerated to a kinetic energy of 500 MeV.

2 Attempt any **four** parts of the following : **5×4=20**

(a) State the essential conditions for observing the phenomenon of interference of light.

(b) Discuss the effect of introducing a thin plate of mica in the path of one of the interfering beams in a biprism experiment.

(c) A square piece of cellophane film with index of refraction 1.5 has a wedge shaped section so that its thickness at two opposit sides is t_1 and t_2. If the number of fringes appearing with wavelength $\lambda = 6000\,\mathring{A}$ is 10, calculate the difference $(t_2 - t_1)$.

(d) In Fraunhofer diffraction at single slit. Show that the intensity of first subsidiary maximum is about 4.5% of that of the principal maximum.

(e) What do you understand by resolving power of an optical instrument ? Explain Rayleigh criterian of resolution.

(f) A telescope of aperture 3.0 cm is focussed on a window at 80 meter distance fitted with a wire mesh of spacing 2 mm. Will the telescope be able to observe the mesh with $\lambda = 5500\,\mathring{A}$?

3 Attempt any **two** parts of the following: **10×2=20**

(a) Explain the phenomenon of double refraction in calcite crystal. Describe the construction, working and use of a Nicol Prism.

(b) (i) Discuss the phenomenon of rotation of the plane of polarisation of light by optically active material.

(ii) Determine the specific rotation of the given sample of the sugar solution if the plane of polarisation is turned through 13.2°. The length of the tube containing 10% sugar solution is 20 cm.

(c) Explain spontaneous and stimulated emission of radiation. How stimulated emission takes place with the exchange of energy between Helium and Neon atoms ?

4 Attempt any **two** parts of the following : **10×2=20**

(a) What is Poynting vector ? Discuss the work-energy theorem for the flow of energy in an electromagnetic field.

(b) (i) Prove that the electromagnetic waves are transverse in nature.

(ii) Calculate the depth of penetration δ at the frequency 71.6MHz in aluminium. The permeability and conductivity for aluminium are $4\pi \times 10^{-7} N/Amp^2$ and 3.54×10^7 Siemen/m respectively.

(c) (i) Prove that the magnetic moment due to orbiting of an electron can be expressed in terms of Bohr magneton.

(ii) An iron rod 20cm long 1cm in diameter and of permeability 1000 is placed inside a solenoid wound uniformly with 600 turns/m. If the current of 0.5amp is passed through solenoid, find the magnetic moment of the rod.

5 Attempt any **four** parts of the following : **5×4=20**

(a) Describe Laue experiment for diffraction of x-rays.

(b) An x-rays photon is found to have its wavelength doubled on being scattered through 90°. Find the wavelength and energy of the incident photon.

(c) Calculate de-Broglie wavelength associated with a proton moving with a velocity equal to $\frac{1}{20}^{th}$ of the velocity of light.

(d) An electron has speed of 600m/s with an accuracy of 0.005%. Calculate the certainty with which we can locate the position of the electron.

(e) Derive time dependent Scrodinger wave equation.

(f) Find the expression for the energy level of a particle in one dimensional box.

Physical Constants :

Planck's constant $h = 6.63 \times 10^{-34} J.s$

Velocity of light in free space $C = 3 \times 10^{8} m/s$

Electron charge $e = 1.6 \times 10^{-19} C$

Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12} F/m$

Permeability of free space $\mu_0 = 4\pi \times 10^{-7} H/m$

Rest mass of electron $m_e = 9.1 \times 10^{-31} kg$

Mass of proton = $1.67 \times 10^{-27} kg$.